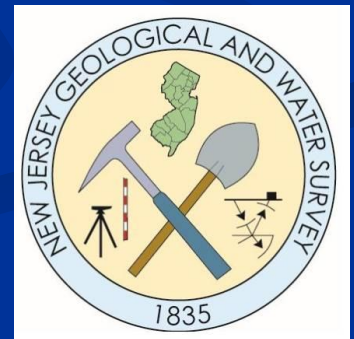


Springs of New Jersey: Characterization and Assessment

May 19, 2016

presented by
Steven Domber,
Ted Pallis and
Ray Bousenberry

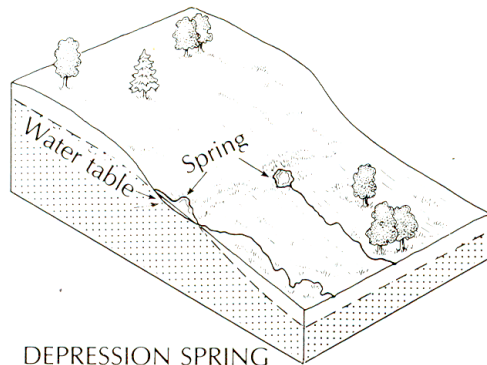


NJ Water Monitoring Council Meeting

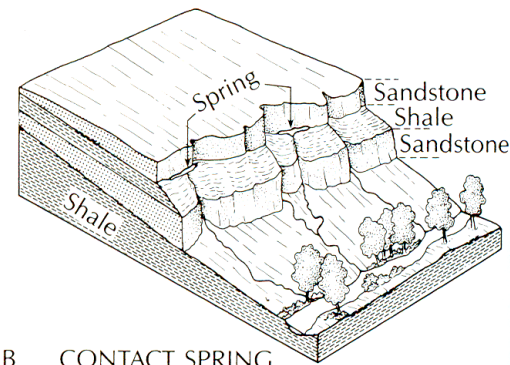
What is a spring?

- No universal definition
- Generally defined as an area of **focused** ground-water discharge
 - Perennial or ephemeral
 - Large or small volumes
 - seeps included in this study
 - Can be located on slopes, wetlands, riparian areas, or under water
 - Water temperature and flow variability

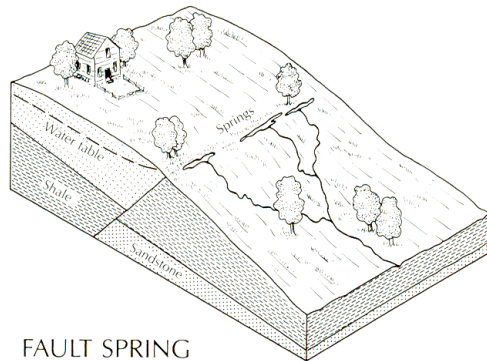
Where do springs form?



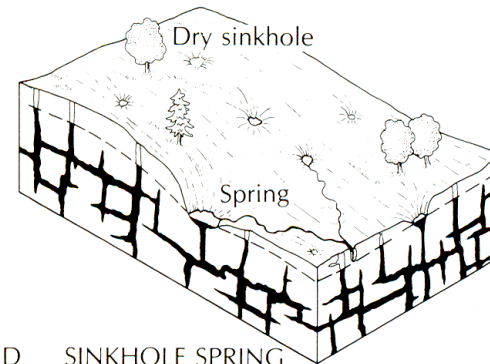
A DEPRESSION SPRING



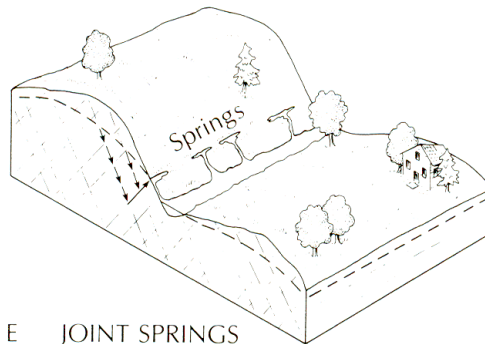
B CONTACT SPRING



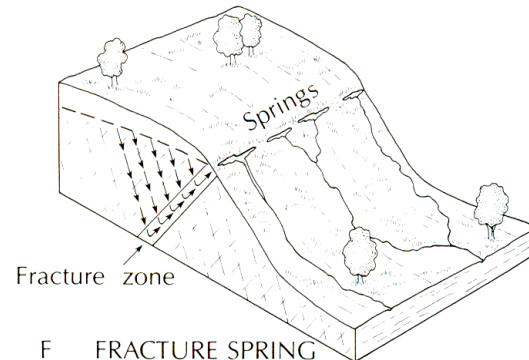
C FAULT SPRING



D SINKHOLE SPRING



E JOINT SPRINGS



F FRACTURE SPRING

Why study springs?

- Springs are known to have unique hydrologic, ecologic, geologic, socio-economic, and historical attributes
- Unlike lakes and wetlands, comprehensive assessments of springs have not typically been conducted
- Many people know of a spring, but few people know much about a spring and its geologic, hydrologic, and biologic attributes

- O.E. Meinzer, USGS, Large Springs in the United States, 1927:

“What are the largest springs in the United States, how much water do they discharge and what geologic conditions produce them are questions of much popular interest and considerable scientific and economic importance. Yet the information in regard to large springs has been so widely scattered and so difficult to interpret that most people have only very vague notions on the subject.”

- Same could be said today

Project History

- 2009 NJGWS Spring Study Workplan
- 2011-2016 EPA Grant “Developing a Wetland Condition Monitoring Network for New Jersey”
 - Spring Classification and Identification section
 - Importance of springs/seeps to headwater wetlands
 - NJ spring classification system and database
 - 14 springs selected for monitoring
- 2014 Montclair State University Master’s Thesis
 - Macroinvertebrate Composition of NJ Springs
- August 2014 detailed water quality sampling
 - Office of Science funded
- 2015 BFBM Aquatic Vertebrate Study

EPA Funded Study

- Included section on importance of springs to wetlands
- Spring classification system and database developed
 - Characterization scheme for springs
 - NJ Springs relational database: physical, discharge, geomorphic, chemical, emergence, geologic, cultural, and ecologic data
 - Field sheets for basic site characterization
- Over 500 potential springs identified
- ~50 with site visits and basic site characterization
- Quarterly water quality sampling at 14 springs
 - pH, conductivity, temperature, dissolved oxygen, nitrate, phosphate

Spring Characterization



Springs Sampled



Water Quality
Sampling



Wetland Assessment

Explanation

 Springs Sampled for Study

PROVINCE

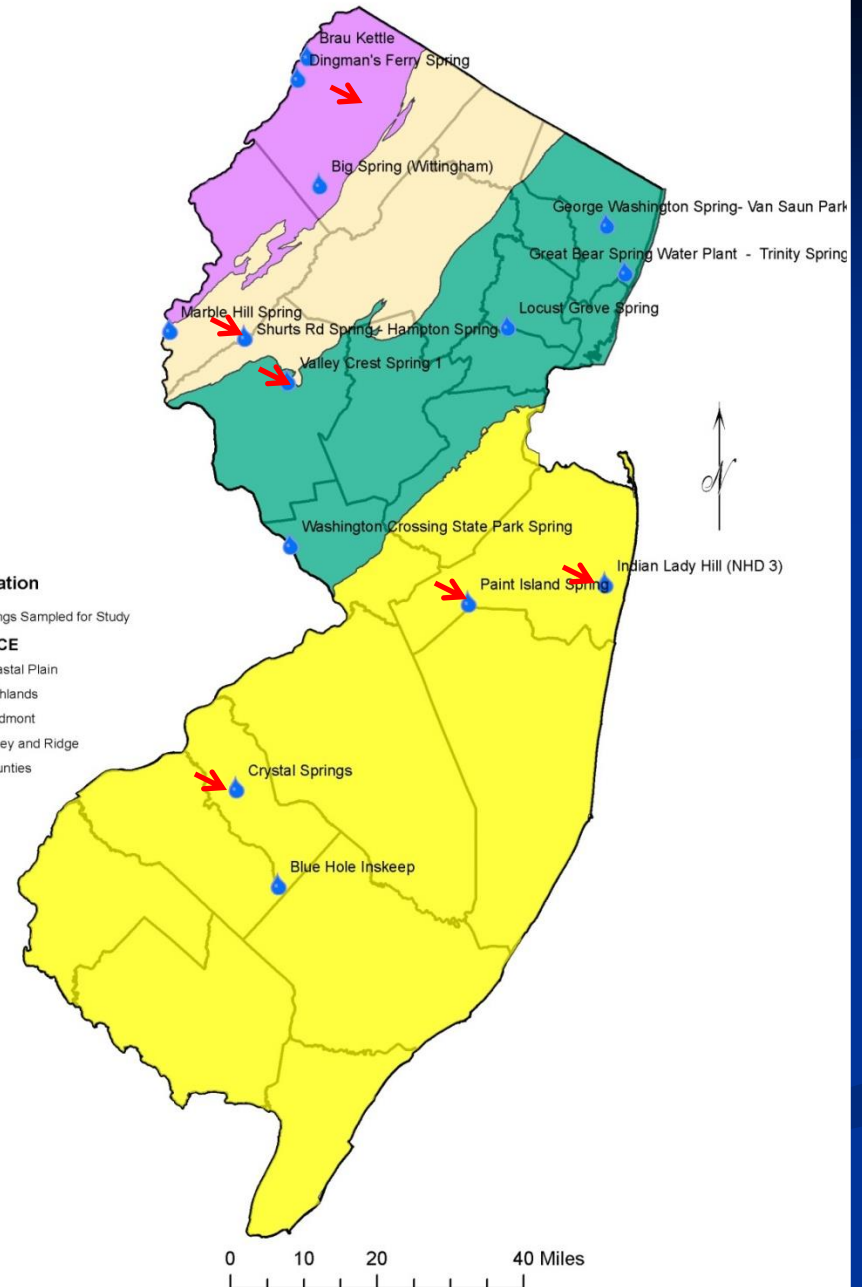
 Coastal Plain

 Highlands

 Piedmont

 Valley and Ridge

 Counties



Great Bear/Trinity Spring, Ridgefield Park

- The Ridgefield Nature Center at Shaler Blvd. at Ray Avenue, in Ridgefield Park is the site of Trinity Spring, the source of water for the old Great Bear spring water bottling plant. It was called trinity spring because there were three springs surfacing in close proximity to each other. In 1920, Great Bear purchased the property and used these springs for bottled water.



Washington Spring, Van Saun Park, Paramus

- Washington Spring is located within a garden setting in Van Saun Park, in Paramus, Bergen County. This spring is reported to have been used by the Continental Army of General George Washington in 1780 and is associated with the movement of his Continental Army through Bergen County during the Revolutionary War.



Crystal Spring, Laurel Springs

- Crystal Spring has long been celebrated for its medicinal qualities and purity, and has been credited with curing numerous cases of long standing kidney and liver diseases. Crystal Spring Park is located in a municipal park (Crystal Springs Park) in Laurel Springs, Camden County. Crystal spring was the favorite location of poet Walt Whitman during his summer stays in the area. Crystal Spring water was bottled and sold in Philadelphia for 15 cents a gallon during the 1800's.



Locust Grove Spring, Milburn Twp.

- Locust Grove Spring is located at the very southern end of the South Mountain Reservation in Millburn Township, Essex County near Glen Ave. & Lackawanna Place. There is a constant stream of water from a pipe but it is fenced in and marked “not safe for human consumption.” This spring has bubbled out of the ground longer than anyone can remember. The NJDEP conducted laboratory analysis for water sample from this spring of 2009. The NJDEP consider the bacteria levels too high for drinking.



The Blue Hole, Monroe Twp.

- The Blue Hole, a spring, is located in Winslow Watershed Management Area (WMA) in Gloucester Co. in the Pinelands off of Piney Hollow Road. This is the most well-known of the multiple Blue Holes of the Pine Barrens.
- The color of the water in this spring is very unusual, as most lakes and ponds in the area are brownish due to large deposits of bog iron and the presence of tannic acid. The Blue Hole is circular and about 70 feet (21 m) across.



Valley Crest Spring, Clinton, Twp.

- The spring was the former water supply for Valley Crest Farm. Today water is taken out of the ground 200 feet uphill from the springhouse from a shallow well and is sold as bottled water to local supermarket chains such as Shop Rite etc.



Washington Crossing State Park Spring, Hopewell, Twp.

- Washington Crossing Spring contains a springhouse and grotto outlet located just west of Route 29 south, River Rd. in Washington Crossing State Park across Route 29 from the Johnson Ferry House. The flow looks to be flowing about 5 Gallons Per Minute (GPM) on July 18, 2011. It outlets into the Delaware and Raritan Canal.



Indian lady Hill Spring, Neptune

- Indian lady Hill Spring was once a source of bottled water sold in New Jersey by the Indian Lady Hill Spring Water Company.



Paint Spring Island, Millstone Township

- Paint Island Spring is located in Millstone Township in Monmouth County. It is a large chalybeate spring. It was named early in the 1800's and is located along the side of Paint Island Road. At one time it was used by the Native Americans for the attractive colors it produced. Later doctors prescribed its waters for medicinal purposes. The spring has the appearance of a small volcano. The water at the top of its crater-like formation has an oily hue. The surrounding marsh is tintured with the rich ochre that is mentioned in the description of the past. The outlet is subterranean and flows free and clear from a small hole beside the stream closer to the bridge along Paint Island Road.



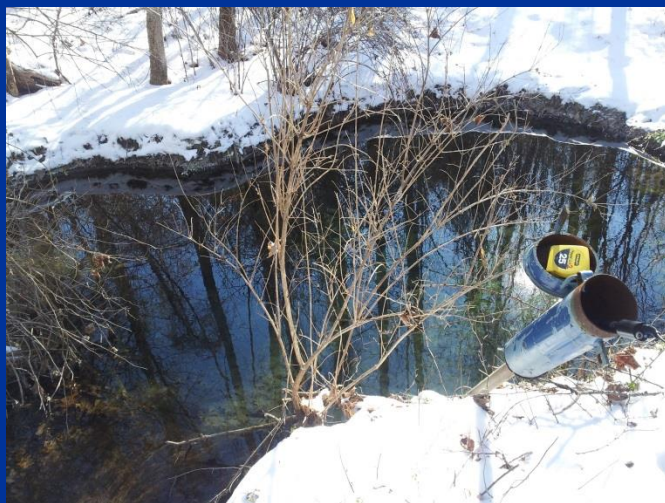
Big Spring Wittingham WMA, Fredon Township

- This is a spring located in the Wittingham Wildlife Management Area. The flow varies throughout the year depending on rainfall. It drains into an old marl quarry.



Brau Kettle, Sandyston Township

- The Brau Kettle is a geological feature known as a karst that is located along the Walpack Ridge in the Delaware Water Gap National Recreation Area. Its name derives from the Dutch for "brewing kettle" or "boiling kettle" which describes how water suddenly bubbles up from the ground. This site is referenced in early French Jesuit and Dutch colonial manuscripts as a landmark near which colonial traders exchanged goods with the Munsee and other local Native American tribes. The feature looks like a sinkhole in dry times during the year. It is known to flow at random, after periods of precipitation, and is thought to be fed by a sinking stream that vanishes in the forest roughly 1,800 feet away.



Dingmans Spring, Sandyston Twp.

- This is a large flow spring on the side of Kitattinny Mountain. Dingmans ferry spring discharges from a hillside through a one meter-wide hole. This subterranean stream flows through a large open joint before appearing on the surface. During periods of high flow, discharge can be greater than 100 gallons per minute.



Marble Mountain Spring, Lopatcong Twp.

- Large spring 1 mile north of Phillipsburg and 1/8 mile south of the old Lizzie Clay Quarry 20' below the Marble Hill and River Roads intersection. For a short time this spring was used as a supply for bottled water.



Shurts Road/Hampton Spring, Washington Township

- This spring emerges from the side of a hill adjacent to farm fields upslope.

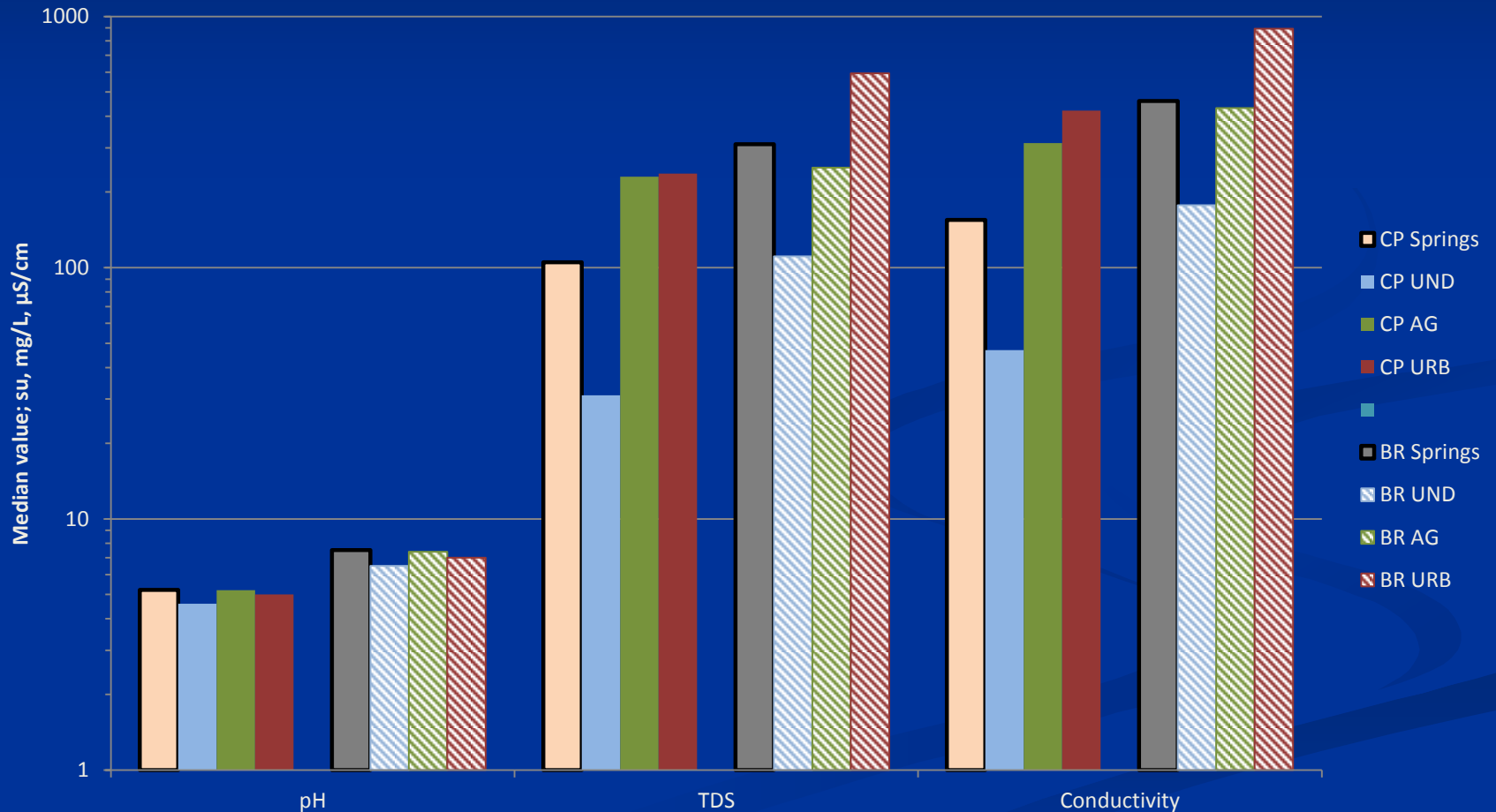


Detailed Water Quality Sampling

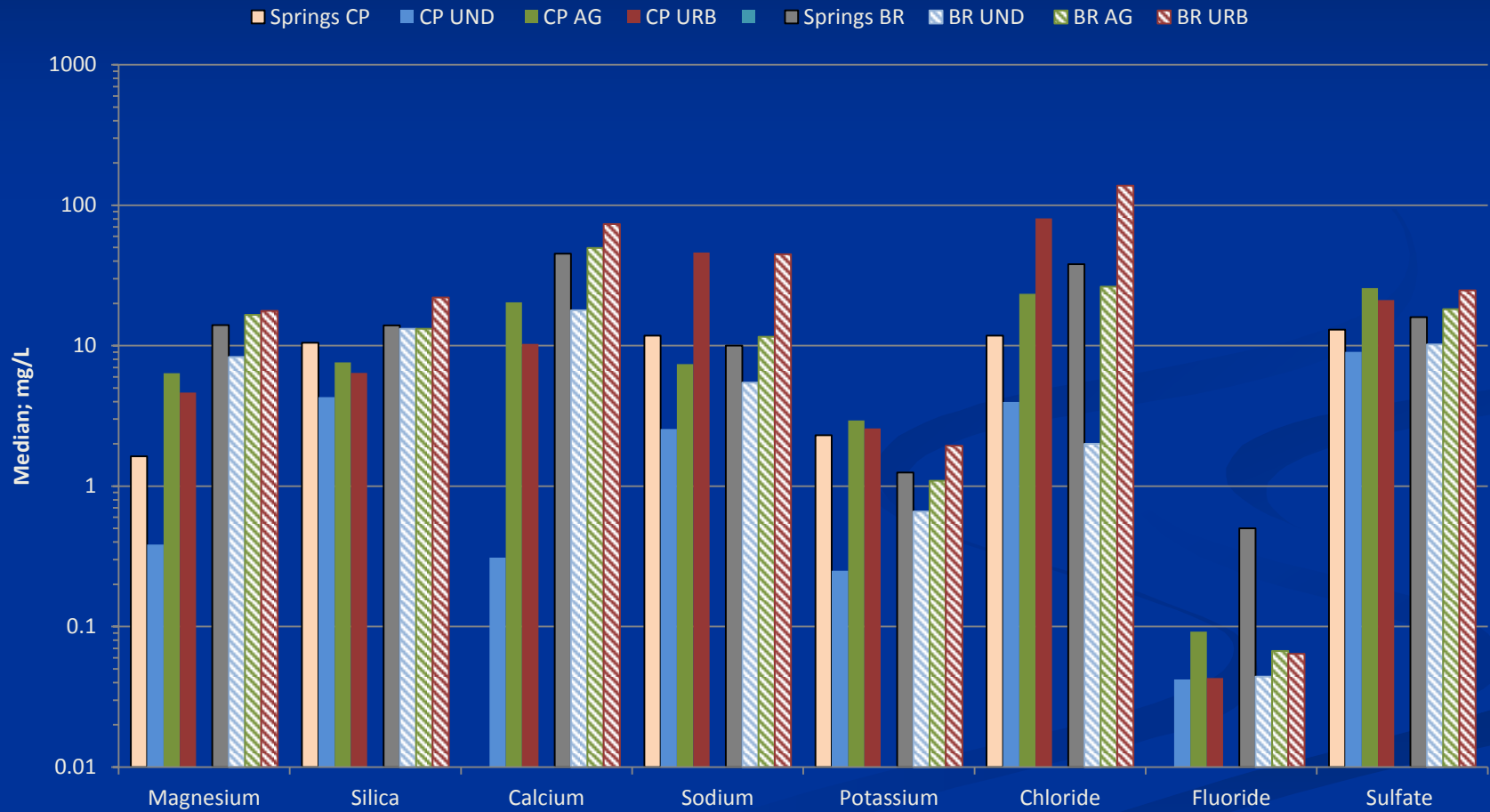
- June 2014 Office of Science funded \$11,409.39 for one round of detailed water quality sampling
- 14 EPA study springs sampled in August of 2014 by NJWGS staff
- Parameters included general chemistry, metals, microbiological, pesticides, radon, and VOCs
- Results and findings completed June 2015

Analyte Category	Analyte	Frequency of Detections	Min Value	Median Value	Max Value	Notes
General Chemistry	Alkalinity	13	3.5	128.0	230	
	Ammonia as N	1	0.12	0.12	0.12	
	Chloride	13	2.6	48.6	250	
	Conductivity	14	36	434.7	1,000	
	Fluoride	1	0.5	0.5	0.5	
	Nitrate	12	0.94	2.3	3.99	
	Nitrite	1	7.7	7.7	7.7	
	Ph	14	4.11	6.8	7.81	
	Sulfate	13	5.1	19.1	54	
	Total Dissolved Solids	14	38	342.0	1,100	
Metals	Total Kjeldahl Nitrogen	14	0.37	1.8	3.4	
	Aluminum	5	27.7	116.5	325	
	Arsenic	6	0.5	1.8	4.1	
	Barium	13	1.13	70.6	283	
	Boron	14	2.5	48.9	437	
	Calcium	6	35.2	71.3	164	
	Chromium	7	0.7	1.0	1.7	
	Copper	11	0.5	0.9	1.7	
	Iron	2	1.3	14.2	27	
	Lead	2	1.4	1.4	1.4	
	Magnesium	14	403	9,269	20,700	
	Manganese	10	0.7	14.1	81.2	
	Nickel	13	0.8	1.6	3.6	
	Potassium	8	1.1	1.7	2.6	
	Selenium	9	0.6	1.0	2.5	
	Silica	14	4730	15,421	35,600	
	Sodium	14	1.7	17.3	70	
	Uranium	5	0.5	2.2	8.2	
Microbiological	E. Coli	12		Presence		
	Total Coliform	14		Presence		
Pesticides	alpha-Chlordane	1	0.019	0.019	0.019	
	Dieldrin	2	0.031	0.0	0.056	
	Hexachlorobenzene	3	0.018	0.0	0.031	
Radon	Gross Alpha Final	14	0	4.0	25.6	
	Radon Average	14	125.9	830.1	3,644.9	
VOC's	Carbon disulfide	2	1.46	1.6	1.7	
	Chloroform	3	0.87	1.0	1.2	
	Methyl tert-Butyl Ether (MTBE)	1	0.78	0.8	0.78	
	Toluene	1	1.77	1.77	1.77	

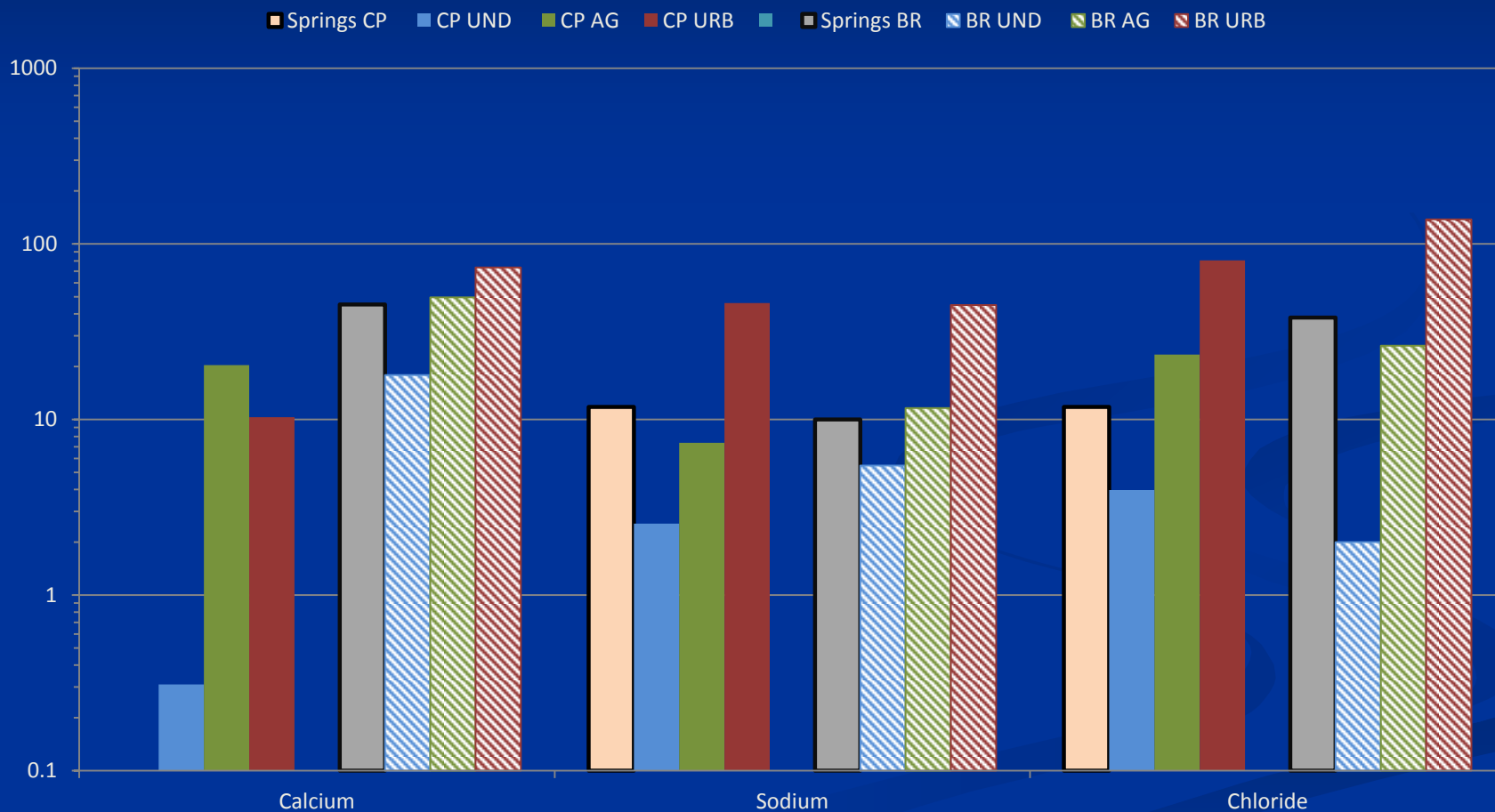
General Chemistry/Field Parameters



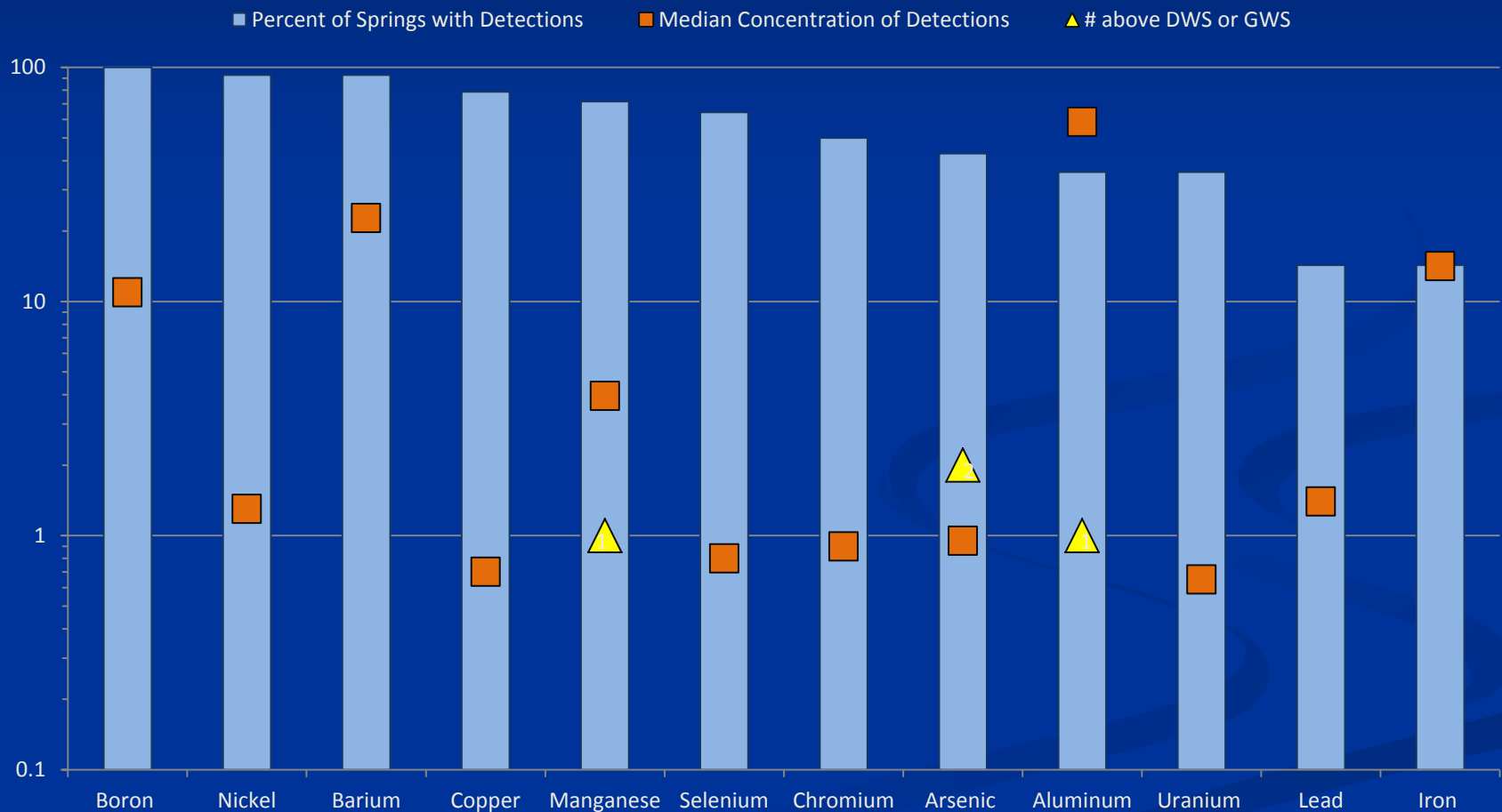
Major Ions



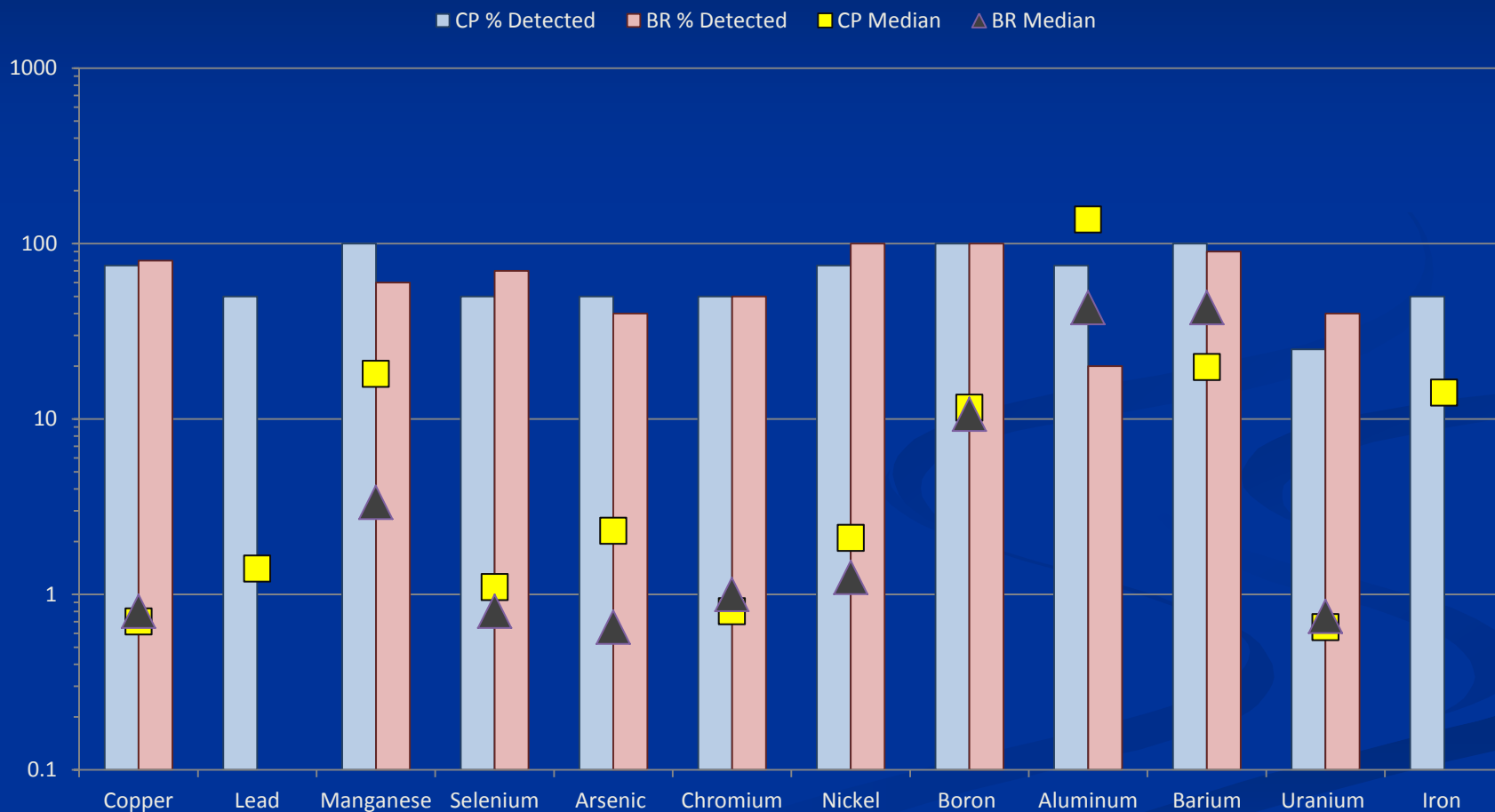
Major Ions Continued



Metals/Trace Elements

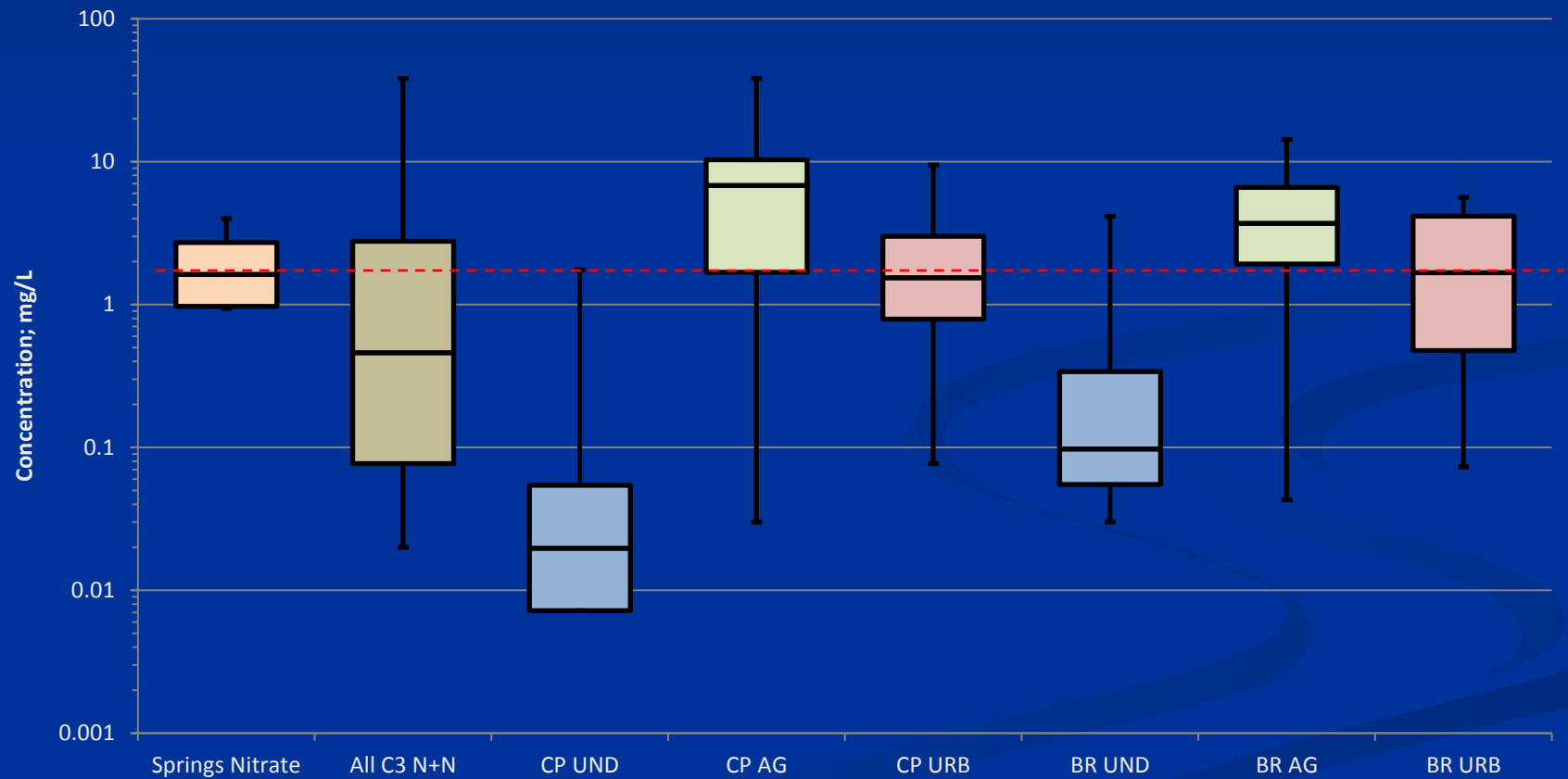


Trace Elements Continued



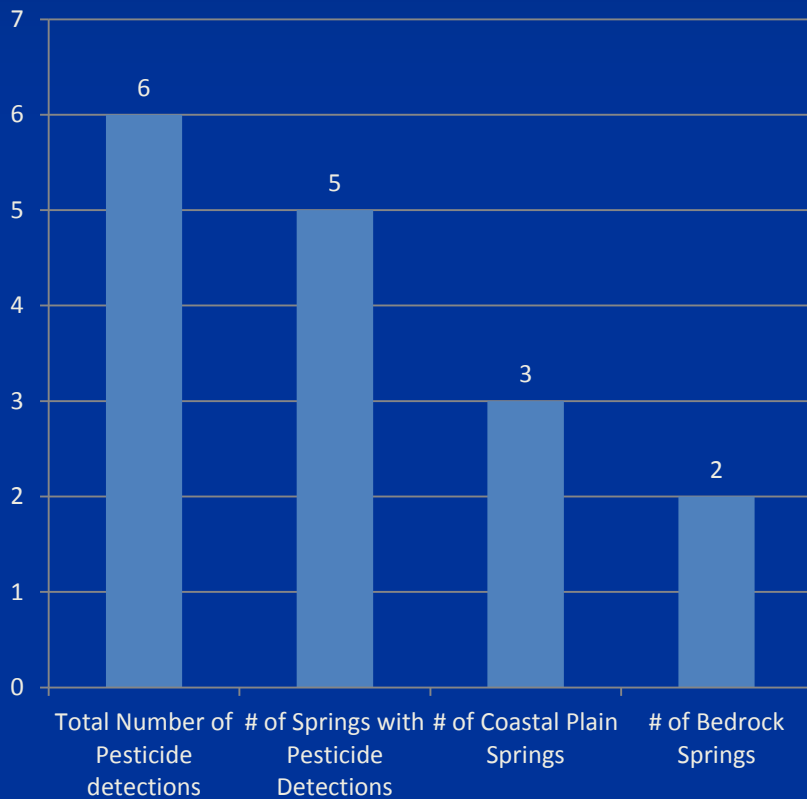
Nutrients

Springs Nitrate and AGWQMN Nitrite + Nitrate



Pesticides

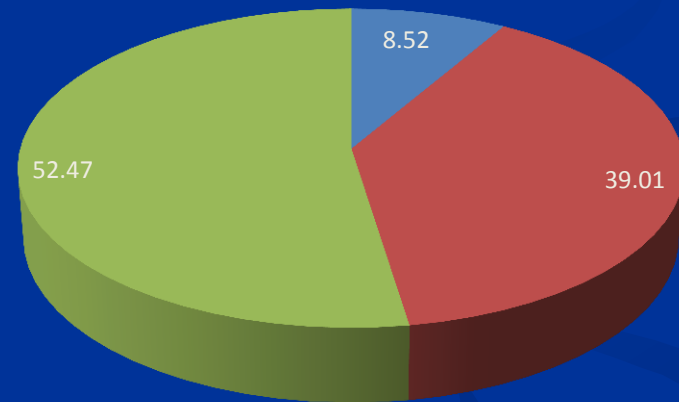
Detections



Concentrations

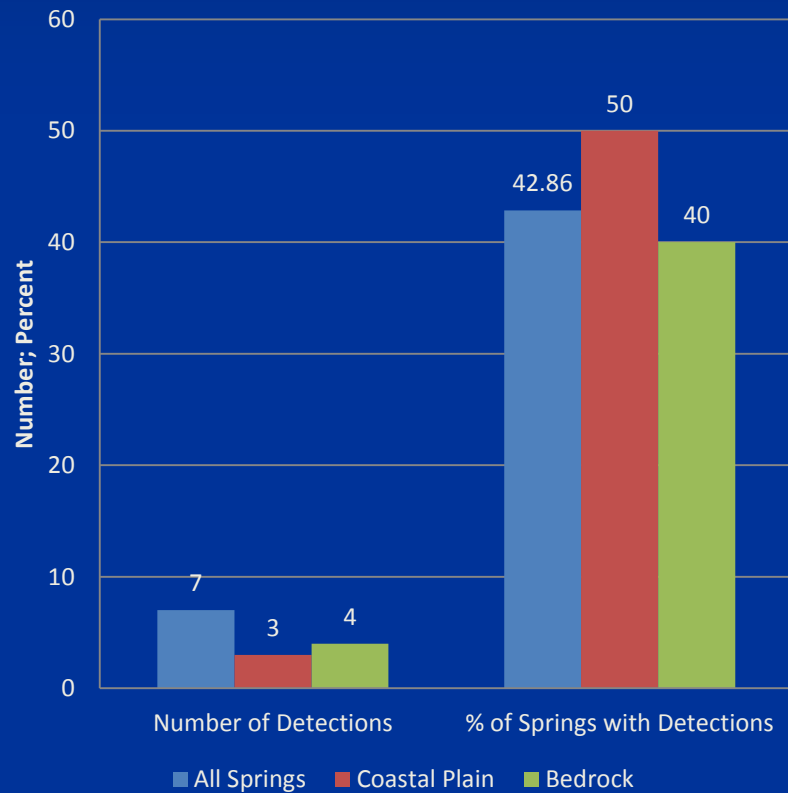
■ alpha-Chlordane ■ Dieldrin ■ Hexachlorobenzene

Total Sum Concentration = 0.223 $\mu\text{g/L}$



VOC

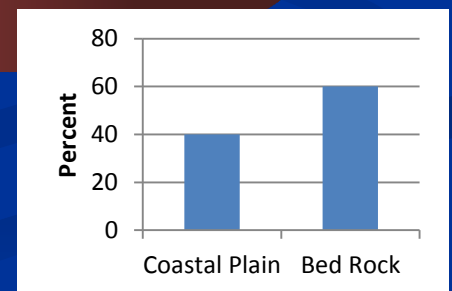
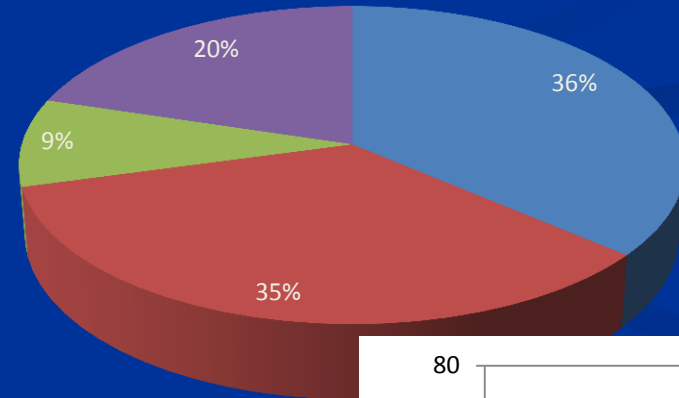
Detection



Concentration

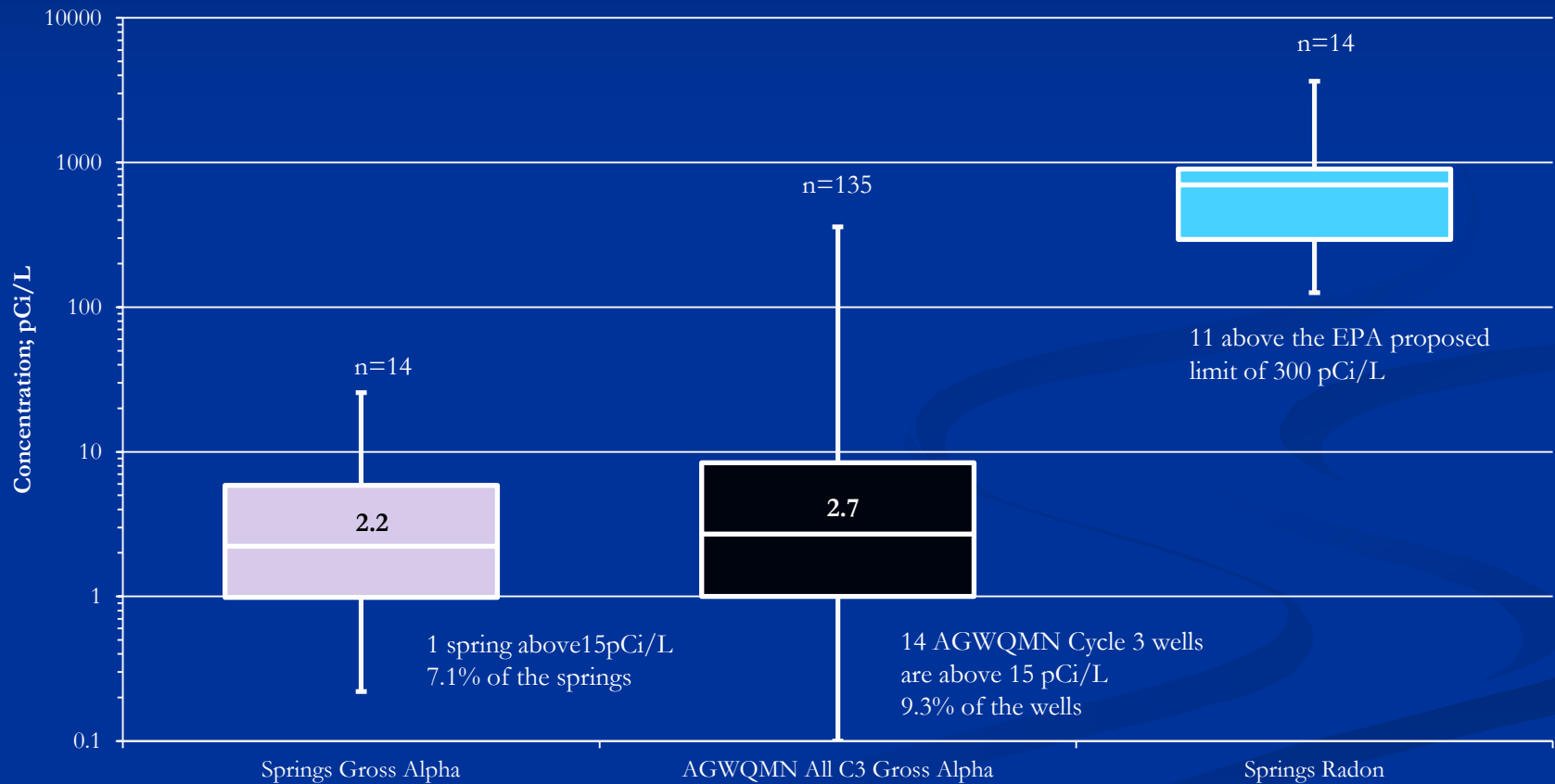
Carbon disulfide Chloroform
Methyl tert-Butyl Ether (MTBE) Toluene

Total sum concentration = 8.72 µg/L



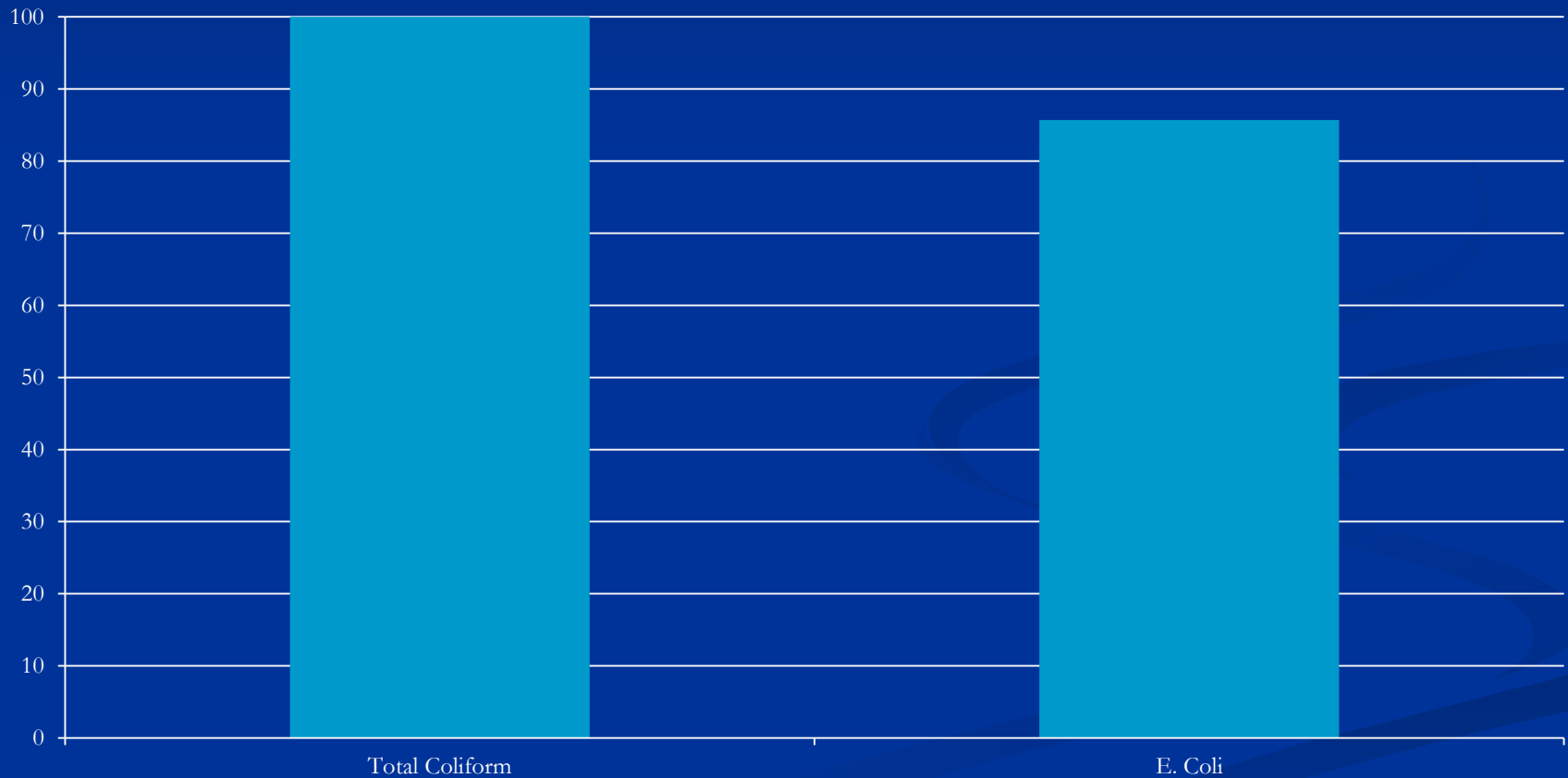
Radionuclides

Springs Gross Alpha, Radon and AGWQMN Cycle 3 Gross Alpha



Bacteria

Percent of Springs with Presence of Bacteria



Spring Water Chemistry

Observations

- The spring water quality is determined by the ground-water quality.
- The spring's water quality is impacted by natural and anthropogenic sources like observed in the AGWQMN.
- The springs' water quality may not be as recently and locally influenced as the AGWQMN monitoring wells.
- To properly characterize spring water quality, more spatial and temporal data is needed.
- To assess if the anthropogenic influences are recent/local, age dating of the spring water would be beneficial or the ability to compare data with an adjacent ground-water monitoring well.